UPPER BRIDGE AT SLATE RUN
(Hilborn Bridge)
Pennsylvania Historic Bridges Recording Project
Spanning Little Pine Creek at State Rt. 414
Slate Run vic.
Lycoming County
Pennsylvania

HAER No. PA-460

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UPPER BRIDGE AT SLATE RUN
(Hilborn Bridge)

HAER No. PA-460

Location:	Spanning Little Pine Creek at State Rt. 414, Slate Run vicinity, Lycoming County, Pennsylvania.
USGS Quadrangle:	Cammal, Pennsylvania (7.5-minute series, 1983).
UTM Coordinates:	18/291500/4595530
Date of Construction:	1890.
Designer:	Berlin Iron Bridge Company (East Berlin, Connecticut).
Builder:	Berlin Iron Bridge Company (East Berlin, Connecticut).
Present Owner:	Pennsylvania Department of Transportation.
Present Use:	Vehicular bridge.
Significance:	The Upper Bridge at Slate Run is a lattice truss, an unusual truss type that was built in the U.S. from about 1857 to the 1890s. Riveting all the members of this statically indeterminate truss required more time and work in the field than most American bridge companies were willing to invest. The Berlin Iron Bridge Company of East Berlin, Connecticut, better known for the construction of lenticular trusses, constructed this span in 1890. The Upper Bridge was listed in the National Register of Historic Places in 1988.
Historian:	Blythe Semmer, August 1997. Revised with an appendix by Stephen G. Buonopane, November 1998.
Project Information:	This bridge was documented by the Historic American Engineering Record (HAER) as part of the Pennsylvania Historic Bridges Recording Project - I, co-sponsored by the Pennsylvania Department of Transportation (PennDOT) and the Pennsylvania Historical and Museum Commission during the summer of 1997. The project was supervised by Eric DeLony, Chief of HAER.

Description

The Upper Bridge at Slate Run is a significant example of a lattice truss. The lattice truss is an unusual product for the Berlin Iron Bridge Company of East Berlin, Connecticut, which built this bridge in 1890. Thc bridge spans Pine Creek at State Route 414 in Brown Township, Lycoming County, Pennsylvania. This single-span lattice through truss is 18'-0" wide, carries one lane of traffic on a 15'-2" roadway, and spans 202'-8", measured from center to center of the end bearings.

The bridge originally had a wooden deck, which was replaced in 1960 with an open steel grid. The deck is supported by six rolled stringers spaced approximately 3'-9" apart and resting on top of built-up steel deck girders.[1] There are open rivet holes in the deck girders where the original stringers were located. There appear to have been four rows of stringers riveted to the deck girders rather than the present six that are welded to plates attached to the top of each deck girder. The stringers may have been replaced during reconstruction of the deck in 1960.[2] The deck girders, which are original, are rounded at either end. There is no evidence of a weld along the curve of the girder flanges. They were likely bent to that shape in the shop.

The roller bearing of the bridge is at the eastern abutment. It was encased in concrete when this abutment was repaired by PennDOT in 1985. Further repairs to the abutments were made by PennDOT in 1996, including the addition of concrete around the original stone of the western abutment. The west abutment holds the span's fixed end. Concrete now encases the stringer at this point on top of the original stone. Most likely during this repair, the original end gusset plates were reinforced with large, thick steel platcs to distribute jacking stresses while lifting the span from its abutments.

The bridge may be constructed of steel, but is most likely wrought iron. [Editor's note: Materials testing completed in September 1997 confirmed that the material is indeed wrought iron.[3]] The Pennsylvania Department of Transportation's bridge inspection report states that "although the bridge is listed as steel in the Bridge Management System forms, the truss members exhibited characteristics found in wrought iron."[4] Wrought iron exhibits corrosion resistance as well as distinctive patterns on fracture surfaces, either of which might have led to

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[1] A.G. Lichtenstein and Associates, "S.R. 0414 over Pine Creek Preliminary Bridge Inspection Report," Mar. 1996, PennDOT Engineering District 3-0, Montoursville, Pa., 5.

[2] Measured drawings of the Upper Bridge at Slate Run reflect the replacement of these stringers.

[3] See U.S. Department of the Interior, Historic American Engineering Record (HAER) No. PA-478, "Structural Study of Pennsylvania Historic Bridges," 1997, Prints and Photographs Division, Library of Congress, Washington, D.C.

[4] A. G. Lichtenstein and Associates, "S.R. 0414," 5.

this determination. The report goes on to suggest that materials testing would determine whether the bridge is built of wrought iron or steel.[5]

The roadway vertical clearance is 12'-0" at the portals and 15'-8" in the center of the roadway. Splice plates are found along the top chord immediately adjacent to every other panel point. A solid plate is also found in the center of the top chord, providing a greater chord area near mid-span. A similar plate has been applied to the bottom chord, although it does not extend as far from the center of the truss as does the plate on the top chord. The portals are ornamented with a decorative fleur-de-lis railing. They bear a bridge plaque that reads "Berlin Iron Bridge Co., East Berlin, Conn." and lists the names of the commissioners who were responsible for the construction of the bridge: A. P. Foresman, William S. Starr, and T. J. Strebeigh. The date of construction, 1890, also appears at the top of the plaque.

An unusual feature of this truss bridge is a 1-1/2"-diameter diagonal strut riveted to the inner vertical surface of the lower chord and to a horizontal plate on the bottom of the lower chord. This member, which is part of the original construction, occurs at every deck girder except one. The northwest corner of the bridge has no strut at panel point L1 on the upstream side of the bridge. The explanation for this omission is unclear, since the placement of these unusual members is consistent and symmetrical throughout the rest of the bridge. The strut may have been installed to decrease the rotation of the lower chord or to distribute the vertical reaction of the girder to both webs of the bottom chord.[6]

The truss itself is quite wide and has substantial portals. These features may have convinced the bridge's designers that lateral motion of the bridge would be minimal. There is only light lateral bracing. The Upper Bridge at Slate Run is characterized by its many small members. The truss type has a light and delicate appearance due to the arrangement of these small parts in a regular pattern. Assembling this bridge required an intensive amount of work in the field, however, since there were no large parts that could be pieced together quickly as in pin-connected bridges.

Pine Creek

Pine Creek cuts a gorge through the Appalachian Mountain system in an area characterized by steep valleys and breathtaking scenery. Part of its valley north of Slate Run forms a deep gorge known as the Grand Canyon of Pennsylvania. The rich forest land of this section of the state fueled a prosperous timber industry in the second half of the nineteenth

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[5] Dr. Dario Gasparini, P.E., professor of civil engineering at Case Western Reserve University, provided information about characteristics of wrought iron.

[6] The following explanation of this member's function was provided by Stephen G. Buonopane, consulting engineer, telephone conversation with the author, 21 Jul. 1997: The downward force of the deck applies a force on the inner plate of the lower chord in a way that could cause inward rotation of the lower chord. Ideally, the downward force would be applied at a point in the center of the two plates of the lower chord. The addition of this diagonal member is a means of resisting the rotation by applying the force at the center-line of the plates.

century. Williamsport, the county seat of Lycoming County, grew wealthy from the milling and timber industries that were headquartered there. In 1860 Williamsport could claim to be the lumber capital of the world.[7] Originally, logs were floated downstream on tributaries of the Susquehanna to the mills at Williamsport, where they were collected in the large log boom constructed at Williamsport in 1851.[8] There the logs were sorted and delivered to individual mill owners. White pine logs were the first major product of the region, and hemlock was widely cut from the 1880s to the turn of the twentieth century. Once builders discovered that wire nails held particularly well in hemlock, the wood that had been second choice to pine gained commercial value, fueling another boom in logging on the West Branch of the Susquehanna River.[9] An 1893 history of the county reported that "from the earliest times lumbering has been the most active industry on Pine Creek and its tributaries."[10] Local milling interests included John S. Tomb and Son and James H. Weed and Company at Slate Run, north of the bridge.[11] The era of prosperity was short-lived, however. The last sawmill in Williamsport closed its doors in 1919.[12]

The expansion of railroads was heralded as a more reliable way to bring logs down the mountain to Williamsport. Although many logs still floated downstream, railroads could move logs when the river was frozen. They began to expand through the West Branch forests in the 1860s, and

> by the 1880s the valleys of the West Branch and its many tributaries were laced with small lumber railroads, linking the mills and the logging camps that grew up alongside them. No other state possessed as diverse an assortment of types and sizes of railroads; few rail lines covered more than fifteen miles.[13]

James B. Weed and Company incorporated the Slate Run Railroad on 17 December 1884, to serve their operations in the area. The railroad was eventually built in 1886 and operated until it was torn up in 1910.[14] This short life span was characteristic of logging railroads, which needed

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[7] Susan Q. Stranahan, *Susquehanna, River of Dreams* (Baltimore: Johns Hopkins Univ. Press, 1993), 96.

[8] Thomas Townsend Taber III, *Sunset Along Susquehanna Waters: Williamsport, Glen Union, Gleasonton, Cammal, Slate Run, Leetonia* (Williamsport, Pa.: Lycoming Printing Co., 1972), 405.

[9] Stranahan, *Susquehanna,* 105-6.

[10] John F. Meginness, *History of Lycoming County, Pennsylvania* (Chicago: Brown, Runk, & Co., 1892), 680.

[11] Meginness, *History of Lycoming County,* 680.

[12] Stranahan, *Susquehanna,* 111.

[13] Stranahan, *Susquehanna,* 106.

[14] Thomas Townsend Taber III, *Railroads of Pennsylvania Encyclopedia and Atlas* (Muncy, Pa.: self-published, 1987), 181.

to harvest timber quickly in order to turn a profit on the expense of building railroad lines into the forest.[15] In 1870, the Pennsylvania legislature passed a bill authorizing the incorporation of the Jersey Shore, Pine Creek & Buffalo Railway. This road was plotted to run from Jersey Shore, Pennsylvania, which was farther south along Pine Creek below Cammal, up Pine Creek and over to Port Allegany in McKean County, a total distance of 118 miles. Construction did not begin on the railroad until 1880 or 1881, and it continued until 1883 under the direction of Reading Railroad and New York Central interests. The Fall Brook Coal Company leased the line in 1884, and the New York Central ultimately assumed the lease on 1 May 1899.[16]

During the lumber boom, a village grew up along Pine Creek at Hilborn, where the Upper Bridge at Slate Run crosses the creek as the road winds up into the mountains. A railway stop for the Pine Creek Railroad is pictured at Hilborn on 1895 and 1897 maps produced by the Bureau of Railways of the Pennsylvania Department of Internal Affairs. The Pine Creek Railroad, as the Jersey Shore, Pine Creek & Buffalo was called after 1884, also had stops at Slate Run and Cedar Run.[17] A post office was established at Hilborn on 26 March 1886, and continued in service until 1891.[18] The evanescence of logging villages leaves behind little record of life during their boom periods. The Upper Bridge at Slate Run is one reminder of the activity that once filled the Pine Creek valley.

Although the Upper Bridge at Slate Run was built as a highway bridge, it is undeniable that the railroad had a profound impact on a remote and sparsely populated region like the Pine Creek Valley. According to structural analysis performed on the Upper Bridge at Slate Run, it was clearly designed to carry loads heavier than typical roadway traffic.[19] A possible explanation is that logging companies were hauling timber out of the forests over this bridge to be loaded onto railroad cars at the Hilborn station. The area certainly did not have heavily traveled highways.

The New York Central's use of lattice trusses might have been influential in the construction of the Upper Bridge at Slate Run because of their interest in the logging railroads that were located in Pine Creek valley. The railroad built the first metal lattice bridge in the U.S. around 1859, and Charles Hilton, one of the New York Central's engineers, designed similar trusses for the railroad's use. However, bridge historian Victor C. Damell has found no evidence

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[15] Stranahan, *Susquehanna,* 107.

[16] Taber, *Railroads of Pennsylvania,* 359-60.

[17] Railroad map, published by the Bureau of Railways of the Department of Internal Affairs, 1897 (railroad collection, Lycoming County Historical Society and Museum archives). The 1895 map is courtesy of Stephen Buonopane.

[18] Meginness, *History of Lycoming County,* 683. See also Spencer L. Kraybill, *Pennsylvania's Pine Creek Valley and Pioneer Families* (Baltimore: Gateway, 1991).

[19] See U.S. Department of the Interior, HAER No. PA-478, "Structural Study."

of the Berlin Iron Bridge Company acting as a fabricator for the New York Central system.[20] The Pennsylvania Railroad used multiple Warren trusses as well, including an 1877 span over the Susquehanna.[21]

Construction of the Upper Bridge at Slate Run

Following a period of record rainfall across the state, the Susquehanna flooded on 1 June 1889, stopping rail service and destroying bridges throughout the area. The log boom at Williamsport was destroyed as waters rose above the cribs. Two hundred million board feet of logs were washed away, only half of which were recovered after they ended up on shore.[22] It was in the wake of this disaster that the Upper Bridge at Slate Run was constructed. Its construction remains something of a mystery. The bridge plaque dates it as 1890, but a notation in the bridge book of the Lycoming County Commissioners lists July 1891 as the date of construction for the "Slate Run Upper Bridge," a lattice truss. No record of the county commissioners' decision to build this bridge above Slate Run is found in their minutes or the road docket, but another case sheds light on the circumstances that must have surrounded its construction.[23] After a destructive flood washed away the previous bridge above Slate Run in Brown Township on 1 June 1889, residents of the Pine Creek area petitioned the county commissioners to move the existing road to the west bank so that it would more conveniently serve the needs of the traveling public. Their plan also included moving the bridge to another location below Slate Run near the public house operated by M. G. Tomb. The petitioners "represented that a new bridge would be too burdensome upon the inhabitants of Brown Township and there is no necessity for the erection of two bridges." The commissioners appointed a party to view the position of the proposed road, and these men made their report in the September session of the Court of Quarter Sessions. Ultimately the plan failed, as a notation dated 7 September 1889, in the road docket states: "The within Report of viewers after due consideration of the Grand Jury is disapproved."[24]

The Warren Truss

The Warren truss is named for James Warren, a British bridge builder who patented its design with Theobald Monzani in 1848.[25] This truss type is characterized by its lack of vertical members; diagonals carry both tension and compression. It was used in the U.S. in the 1860s but

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[20] Victor C. Darnell, telephone conversation with author, 26 Aug. 1997.

[21] Victor C. Darnell, to Dr. Mark M. Brown, 30 Jul. 1997.

[22] Taber, *Sunset Along Susquehanna Waters,* 405.

[23] Lycoming County, Pennsylvania, *County Commissioners' Minutes* are missing for 1890.

[24] Lycoming County, Pennsylvania, *Road Docket,* 8:675-77.

[25] Donald C. Jackson, *Great American Bridges and Dams* (New York: John Wiley & Sons, 1988), 27.

was not as popular as the Pratt truss. Warren trusses were constructed as both railroad and highway bridges. Superposed multiple Warrens are statically indeterminate because all of the connections are riveted rather than pinned. American engineers and bridge builders preferred statically determinate pin-connected bridges, which were easier to design and quicker to assemble in the field. The development of pneumatic riveting systems in the 1880s and 1890s, however, made it easier to assemble the riveted connections in the field.[26]

The Upper Bridge at Slate Run is best described as a lattice truss. An interesting feature of the bridge's design is the fact that the diagonals intersect five panel points in their course from upper to lower chord. The effect of this arrangement is like the superimposition of five separate Warren trusses on one another. Therefore this bridge has been referred to as a Warren quintangular truss.[27] In Warren quadrangular trusses, a more common variety, the diagonals intersect four panel points.

The Berlin Iron Bridge Company

Bridge companies proliferated during the second half of the nineteenth century, especially in the northeast and Midwest.[28] Eaeh often built a particular truss as a specialty and marketed their designs to local governments and railroads across the country. The Upper Bridge at Slate Run was built by the Berlin Iron Bridge Company of East Berlin, Connecticut, which was known for the construction of lenticular trusses. The firm began as the Corrugated Metal Company in 1873 and originally manufactured corrugated iron for buildings. That venture led them to manufacture iron roof trusses to support the corrugated sheets, and the progression from roof trusses to bridges was natural. In 1877, S. C. Wilcox became president and the firm was reorganized. The Corrugated Metal Company changed its name to Berlin Iron Bridge Company in 1883. At Wilcox's death in 1886, Charles M. Jarvis became president.[29] Ultimately the firm merged with more than twenty-four other companies to become the American Bridge Company that J. P. Morgan organized in 1900 as a subsidiary of United States Steel Corporation.[30]

The Berlin Iron Bridge Company built its reputation on the lenticular or parabolic truss. All but one lenticular truss in this country were built by Berlin. (The exception is Gustav

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[26] Jackson, *Great American Bridges and Dams,* 29.

[27] For more information on the unusual truss arrangement of this bridge, see Appendix A of this report, and U.S. Department of the Interior, HAER No. PA-478, "Structural Study."

[28] Jackson, *Great American Bridges and Dams,* 29.

[29]Victor C. Darnell, "Lenticular Bridges from East Berlin, Connecticut," *IA: Journal of the Society for Industrial Archaeology* 5 (1979): 124.

[30] Jackson, *Great American Bridges and Dams,* 30.

Lindenthal's Smithfield Street Bridge in Pittsburgh.[31]) The company capitalized on the fact that the lenticular truss required less material than other truss types. Reduced material meant lower cost to the county commissioners that decided between the offers of several bridge companies and frequently awarded contracts based on a bidding process. Ultimately the type of truss constructed at a crossing was the decision of the buyer; various truss types could serve the same crossing equally if well constructed.[32]

The reason that a lattice truss was chosen for the Upper Bridge at Slate Run remains a mystery, but the decision could have been affected by factors as simple as the salesmanship of the Berlin agent or as complex as the railroad and logging interests that divided up the Pine Creek Valley. Bridge builders were debating the merits of riveted and pinned connections in the 1890s as well, and this unusual product of the Berlin Iron Bridge Company may owe its construction to the company's desire to experiment with construction methods being discussed in the professional world.[33] The bridge stands as a reminder of the variety of truss types that characterized the era of American bridge companies.

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[31] See U.S. Department of the Interior, HAER No. PA-2, "Smithfield Street Bridge," 1974, Prints and Photographs Division, Library of Congress, Washington, D.C.

[32] Victor C. Darnell, to Dr. Mark M. Brown, 30 Jul. 1997.

[33] Berlin definitely built one other riveted multiple Warren truss in Dummerston, Vermont. This bridge was pictured in a Berlin catalog published in the mid-1890s. Victor C. Darnell, telephone conversation with author, 26 Aug. 1997.

SOURCES CONSULTED

Buonopane, Stephen G. Telephone conversation with author, 21 Jul. 1997.

Condit, Carl W. *American Building Art: The Nineteenth Century.* New York: Oxford Univ. Press, 1960.

Darnell, Victor C. "Lenticular Bridges form East Berlin, Connecticut." *IA: Journal of the Society for Industrial Archaeology* 5 (1979): 19-32.

______. To Dr. Mark M. Brown, 30 Jul. 1997.

______. Telephone conversation with author, 26 Aug. 1997.

Headwaters to Hardwoods: The Folklore, Cultural History and Traditional Arts of the Pennsylvania Northern Tier. Mansfield, Pa.: Northern Tier Cultural Alliance, 1997.

Jackson, Donald C. *Great American Bridges and Dams.* New York: John Wiley & Sons, 1988.

Kraybill, Spencer L. *Pennsylvania's Pine Creek Valley and Pioneer Families.* Baltimore: Gateway, 1991.

A. G. Lichtenstein and Associates. "S.R. 0414 over the Pine Creek Preliminary Bridge Inspection Report," March 1996. PennDOT Engineering District 3-0, Montoursville, Pa.

Lycoming County Historical Society and Museum archives. Railroad collection.

Lycoming County, Pennsylvania. *County Commissioner's Minutes.* Recorder of Deeds Office, Lycoming County Courthouse, Williamsport, Pa.

______. *Road Docket.* Office of Prothonotary, Lycoming County Courthouse, Williamsport, Pa.

Meginness, John F. *History of Lycoming County, Pennsylvania.* Chicago: Brown, Runk & Co., 1892.

Pennsylvania Department of Transportation. Bridge inspection file, BMS No. 41-0414-0330-0000. PennDOT District 3-0, Montoursville, Pa.

______. *Historic Highway Bridges in Pennsylvania.* Harrisburg: Pennsylvania Department of Transportation, 1986.

Stranahan, Susan Q. *Susquehanna, River of Dreams.* Baltimore: Johns Hopkins Univ. Press, 1993.

Taber, Thomas Townsend III. *Railroads of Pennsylvania Encyclopedia and Atlas.* Muncy, Pa.: self-published, 1987.

______. *Sunset Along Susquehanna Waters: Williamsport, Glen Union, Gleasonton, Cammal, Slate Run, Leetonia.* Williamsport, Pa.: Lycoming Printing Company, 1972.

APPENDIX A: Geometric Analysis

Engineer: Stephen G. Buonopane, November 1998.

The engineering study of the Upper Bridge at Slate Run noted several unusual geometric features for which no sound explanation could be proposed.* In addition, historical research found little surviving written evidence documenting the circumstances surrounding the bridge's design and construction. This Appendix proposes an explanation for the bridge's longitudinal asymmetry, and in doing so adds significantly to the knowledge of the bridge's origins and construction.

Figure 1 shows the configuration of the bridge as it stands today. The longitudinal asymmetry of each truss is a result of unequal length end panels — 9'-0" at the north end of the bridge, 13'-6" at the south. In the present configuration there is no clear engineering reason for the bridge to have different length end panels.

However, end panels of different lengths have been used as a convenient means of adapting truss bridges to skew crossings. Figure 2 shows a schematic diagram for a skew truss bridge from Merriman and Jacoby's *Roofs and Bridges.*† Here the end panels of different lengths are positioned at opposite ends of the bridge; the long panel on one truss is matched with the short panel of the parallel truss. Since the lines of the abutments (lines *a-a'* and *i-i'* in Figure 2) would be parallel, the length of panel *a-b* would be equal to that of *h'-i'*; likewise the length of panel *a'-b'* would equal that of *h-i*. The asymmetric end panels result in the alignment of the interior panel points, and allows the floor beams to meet the lower chord at right angles, greatly simplifying the floor beam-to-lower chord connections.

The longitudinal asymmetry of the Upper Bridge at Slate Run, as it stands today, is a result of its having been originally designed for a skew crossing at some other location. Figure 3 shows the proposed original configuration of the bridge for a skew crossing and the transformation necessary to reconfigure its components into the bridge as it stands today for a right-angled crossing. In the original skew design, the 9'-0" end panels would have been positioned at the north end of the east truss and at the south end of the west truss. The 13'-6" end panels would have been positioned at the south end of the east truss and at the north end of the west truss. The width of the bridge is 18'-0", measured between chord center lines, and thus the skew angle of the original bridge must have been about 14.3 degrees. In order to adapt the skew bridge to the right-angled crossing at its present location, the west truss would have been rotated

* U.S. Department of the Interior, Historic American Engineering Record (HAER) No. PA-478, "Structural Study of Pennsylvania Historic Bridges," 1997, Prints and Photographs Division, Library of Congress, Washington, D.C.

† Mansfield Merriman and Henry S. Jacoby, *Roofs and Bridges, Part I: Stresses in Simple Trusses,* 6th ed. (New York: John Wiley & Sons, 1922).

such that its original inside face would now appear on the outside of the bridge. The east truss would simply have been relocated without any rotation.

Sections A and B in Figure 3 also reveal that in rotating the west truss, the relationship between the plates of its lower chord and the floor beam is altered. In the original configuration a transverse floor beam would have been riveted to the inside plate of the lower chord of the west truss at each panel point. However, after rotating the west truss to its current configuration the original outside plate is now positioned adjacent to the floor beam and the original inside plate, which had been connected to the floor beam, is no longer adjacent to the floor beam. In order to reconnect the floor beam to the lower chord, new holes were reamed in the original outside plate of the lower chord and the floor beam riveted to the chord plate. The original inside plate now had six existing holes, which previously held rivets to connect the floor beam, that were no longer necessary. These non-functional holes in the lower chord of the west truss were filled with blank rivets. Figures 4 and 5 show views of the east and west lower chords, respectively, of the Upper Bridge at Slate Run. The lower chord of the west truss has six blank rivets at each panel point which simply fill the existing rivet holes with no other structural function. The lower chord of the east truss has no such holes or blank rivets.

The evidence presented in this Appendix clearly shows that the Upper Bridge at Slate Run was not designed for its present location, but instead for a skew crossing. The bridge may have stood elsewhere in its original skew configuration, or it may have only been designed and fabricated for its original installation and adapted for its present location and configuration without ever being in service elsewhere. This evidence of relocation of the bridge supports other information uncovered by the historical and engineering studies. For example, the bridge was clearly designed to support the weight of railroad cars, although no railway crossing has ever existed at this location at Pine Creek. The discrepancy in construction dates as recorded by the bridge plaque (1890) and the records of the Lycoming County Commissioners (July 1891) may also be a result of relocation. The Upper Bridge at Slate Run was constructed at its present location in the wake of the June 1889 floods which undoubtedly damaged many bridges in the Susquehanna River valley, however the historical circumstances which made this bridge available for relocation remain undocumented.

SOURCES CONSULTED

Merriman, Mansfield, and Henry S. Jacoby. *Roofs and Bridges, Part I: Stresses in Simple Trusses.* 6th ed. New York: John Wiley & Sons, 1922.

U.S. Department of the Interior, Historic American Engineering Record (HAER) No. PA-478, "Structural Study of Pennsylvania Historic Bridges," 1997. Prints and Photographs Division, Library of Congress, Washington, D.C.

APPENDIX B: Figures

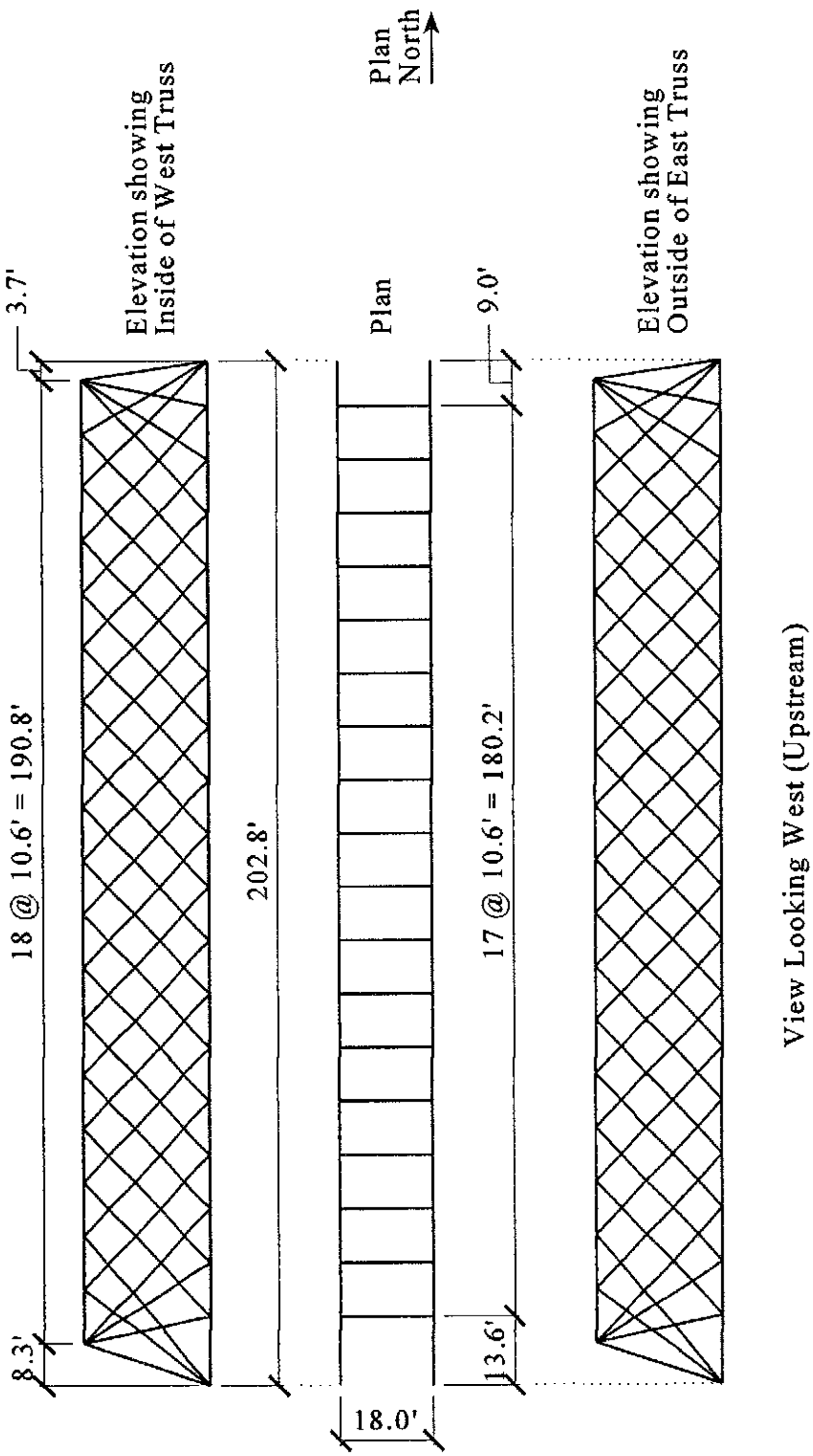

Figure 1. Present configuration of the Upper Bridge at Slate Run. Drawing by author, Nov. 1998.

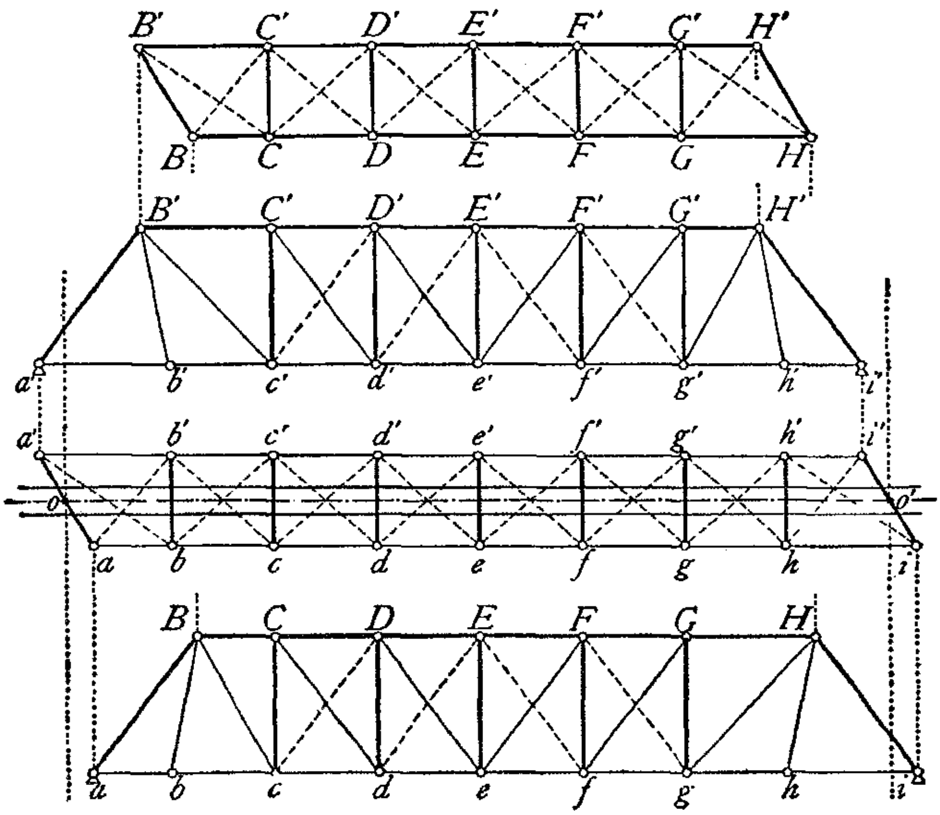

Fig. 49.

Figure 2. Schematic design of a truss for a skew crossing. Source: Mansfield Merriman and Henry S. Jacoby, *Roofs and Bridges, Part I: Stresses in Simple Trusses,* 6th ed. (New York: John Wiley & Sons, 1922), 151.

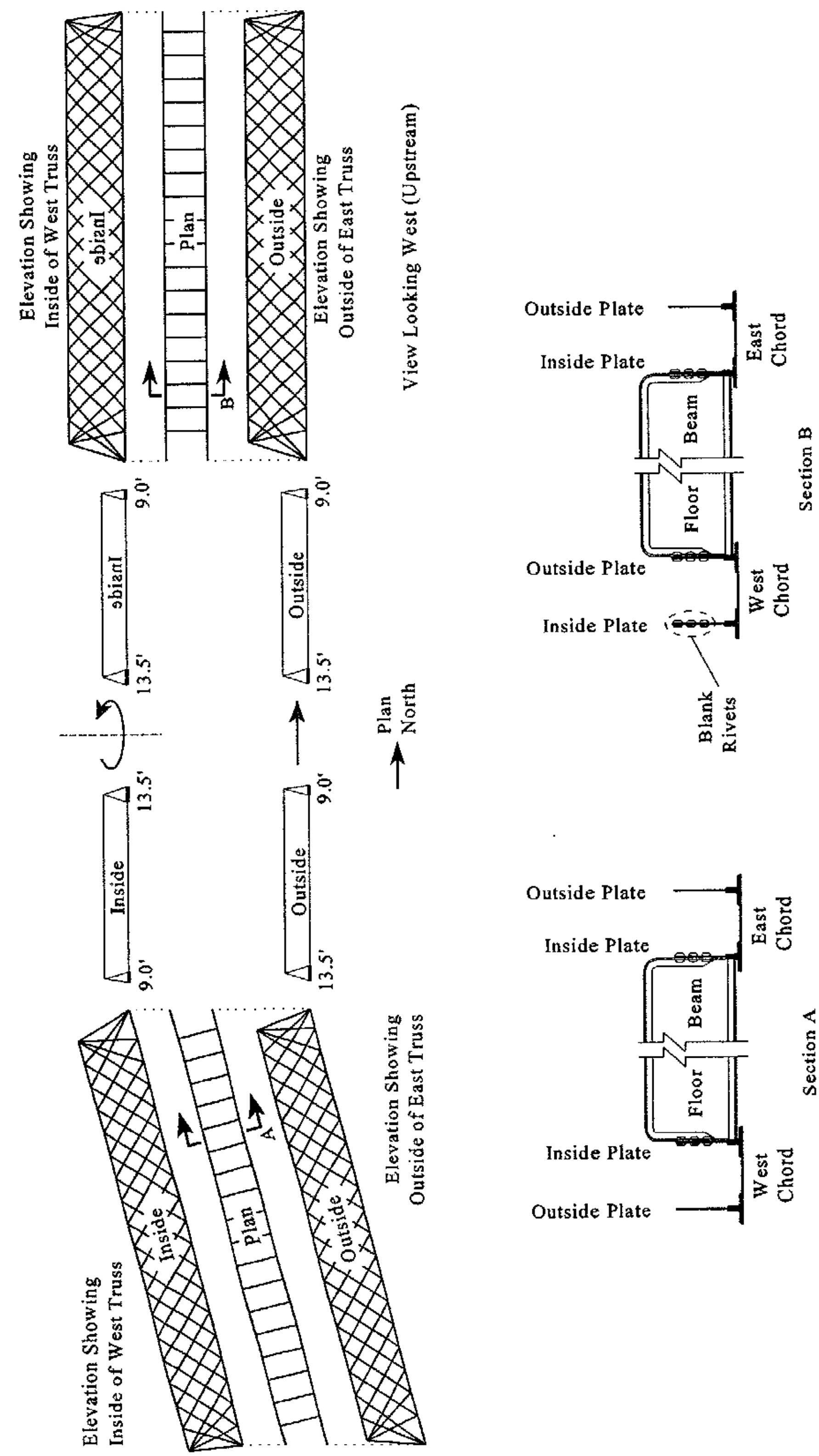

Figure 3. Original configuration of bridge as a skew crossing and transformation to present configuration. Drawing by author, Nov. 1998.

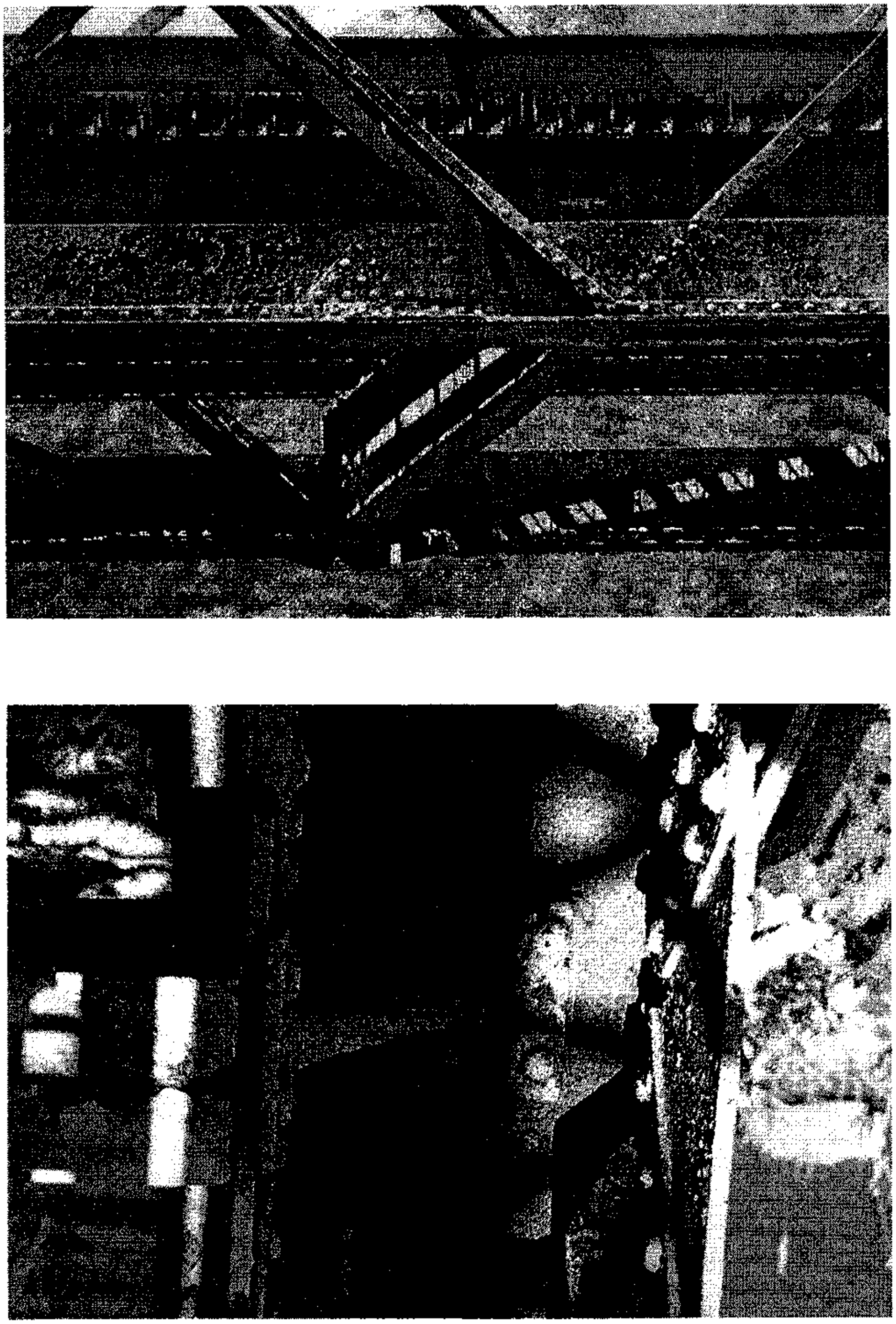

Figure 4. Views of lower chord of east truss. Photographs by author, Aug. 1997.

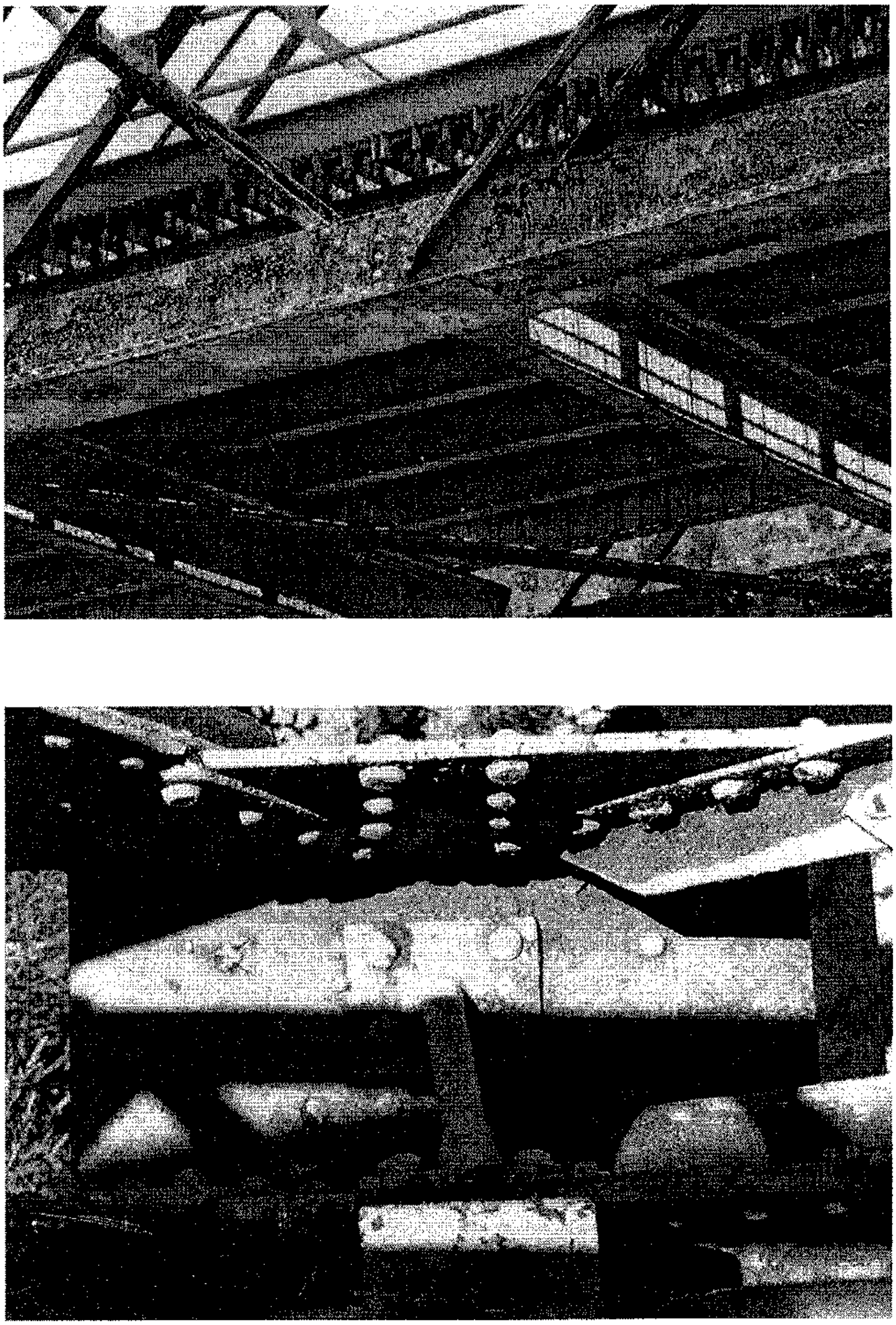

Figure 5. Views of lower chord of west truss, showing blank rivets. Photographs by author, Aug. 1997.